CLAIMS

1. A multibeam antenna reception device comprising:

a receiving array antenna including N (N: an integer not less than 1) receiving antenna elements;

N radio receiver sections corresponding to the receiving antenna elements, respectively;

M (M: an integer not less than 1) receive beam forming sections; and

L (L: an integer not less than 1) user demodulation blocks;

Wherein, at the time of the detection of a path defined by a pair of a receive beam number as an arrival direction and a path delay as arrival timing with respect to the multipath of each user, the path detection range at the current time is controlled based on information on paths detected prior to the current time.

2. The multibeam antenna reception device according to claim 1, wherein each of the user demodulation blocks includes:

M receive beam path detection sections for detecting path delay with respect to each user from the outputs of the M receive beam forming sections;

a path delay/ receive beam selection section for selecting one or more pairs of receive beam numbers and path delays for use in demodulation based on pairs of receive beam numbers and path delays and information on user signal reception quality in the respective pairs of the receive beam numbers and the path delays output from the M receive beam path detection sections;

a demodulation processing section for performing demodulation with the one or more pairs of the receive beam numbers and the path delays selected by the path delay/ receive beam selection section; and

a path detection control section for controlling the path detection

range at the current time for the respective M receive beam path detection sections based on pairs of receive beam numbers and path delays detected prior to the current time and information on user signal reception quality in the respective pairs of the receive beam numbers and the path delays output from the M receive beam path detection sections.

3. The multibeam antenna reception device according to claim 2, wherein the path detection control section controls the path detection range at the current time for the respective M receive beam path detection sections based on the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays output from the M receive beam path detection sections so that the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays detected prior to the current time.

4. The multibeam antenna reception device according to claim 3, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays detected prior to the current time, a combination of the receive beam number and the path delay is used as a condition for defining the vicinity.

5. The multibeam antenna reception device according to claim 3, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays detected prior to the current time, ± S (S: an integer not more than the number of receive beams M) receive beams adjacent to the pair are used as a condition for defining the vicinity.

6. The multibeam antenna reception device according to claim 3, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays detected prior to the current time, a path delay of ± R (R: a real number not more than the maximum value of the path detection range) is used as a condition for defining the vicinity.

7. The multibeam antenna reception device according to claim 3, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays detected prior to the current time, ± S (S: an integer not more than the number of receive beams M) receive beams adjacent to the pair and a path delay of ± R (R: a real number not more than the maximum value of the path detection range) are used as a condition for defining the vicinity.

8. The multibeam antenna reception device according to claim 2, wherein the path detection control section controls the path detection range at the current time for the respective M receive beam path detection sections based on the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays output from the M receive beam path detection sections so that the path detection range is confined only to the vicinity of respective pairs of receive beam numbers and path delays at the current time calculated from the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays.

9. The multibeam antenna reception device according to claim 8, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays at the current time calculated from the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, a combination of the receive beam number and the path delay is used as a condition for defining the vicinity.

10. The multibeam antenna reception device according to claim 8, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays at the current time calculated from the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, ± S (S: an integer not more than the number of receive beams M) receive beams adjacent to the pair are used as a condition for defining the vicinity.

11. The multibeam antenna reception device according to claim 8, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays at the current time calculated from the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, a path delay of ± R (R: a real number not more than the maximum value of the path detection range) is used as a condition for defining the vicinity.

12. The multibeam antenna reception device according to claim 8, wherein, when the path detection control section confines the path detection range only to the vicinity of the respective pairs of the receive beam numbers and the path delays at the current time calculated from the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, ± S (S: an integer not more than the number of receive beams M) receive beams adjacent to the pair and a path delay of ± R (R: a real number not more than the maximum value of the path detection range) are used as a condition for defining the vicinity.

13. The multibeam antenna reception device according to claim 2, wherein, when the path detection control section controls the path detection range at the current time for the respective M receive beam path detection sections based on the pairs of the receive beam numbers and the path delays detected prior to the current time and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays output from the M receive beam path detection sections, the path detection control section confines the path detection range using only one or more pairs of receive beam numbers and path delays detected prior to the current time, which are selected according to a certain standard, and information on user signal reception quality in the pairs of the receive beam numbers and the path delays.

14. The multibeam antenna reception device according to claim 13, wherein, as the pair of the receive beam number and the path delay detected prior to the current time which is selected according to a certain standard, the top P (P: an integer not less than 1) pairs of receive beam numbers and path delays excellent in user signal reception quality are selected.

15. The multibeam antenna reception device according to claim 13, wherein, as the pair of the receive beam number and the path delay detected prior to the current time which is selected according to a certain standard, at most Q (Q: an integer not less than 1) pairs of receive beam numbers and path delays in which the user signal reception quality meets a certain standard of reception quality are selected.

16. The multibeam antenna reception device according to claim 13, wherein, as the pair of the receive beam number and the path delay detected prior to the current time which is selected according to a certain standard, the pair of the receive beam number and the path delay selected by the path delay/ receive beam selection section is used.

17. The multibeam antenna reception device according to claim 2, wherein, in the case where the path delay/ receive beam selection section has selected no pair of a receive beam number and a path delay suitable for use in demodulation at the current time, the path detection control section sets the path detection range to cover all path delays and all receive beams.

18. The multibeam antenna reception device according to claim 2, wherein, immediately after the initiation of reception, the path detection control section sets the path detection range to cover all path delays and all receive beams.

19. The multibeam antenna reception device according to claim 2, wherein the path detection control section sets the path detection range to cover all path delays and all receive beams periodically at intervals longer than the path detection interval.

20. The multibeam antenna reception device according to one of claims 17 to 19, wherein, when the path detection control section sets the path detection range to cover all path delays and all receive beams, the resolution of the detection is reduced.

21. A multibeam reception method applied to a multibeam antenna transmission/ reception device receiving at least one receive beam, comprising:

a beam path detecting step for detecting path delay with respect to each user from the receive beam;

a path detection range setting step for setting the path detection range based on pairs of receive beam numbers and path delays previously detected in the beam path detecting step and information on user signal reception quality in the respective pairs of the receive beam numbers and the path delays;

a path selecting step for selecting one or more pairs of receive beam numbers and path delays for use in demodulation based on the pairs of the receive beam numbers and the path delays detected in the beam path detecting step, the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, and the path detection range set in the path detection range setting step; and

a demodulating step for performing demodulation with the one or more pairs of the receive beam numbers and the path delays selected in the path selecting step.

22. The multibeam reception method according to claim 21, wherein, in the path detection range setting step, the path detection range is set so that the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays previously detected.

23. The multibeam reception method according to claim 22, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays previously detected, a combination of the receive beam number and the path delay is used as a condition for defining the vicinity.

24. The multibeam reception method according to claim 22, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays previously detected, at least one receive beam adjacent to the pair is used to define the vicinity.

25. The multibeam reception method according to claim 22, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays previously detected, at least one path delay in the maximum path detection range is used to define the vicinity.

26. The multibeam reception method according to claim 22, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays previously detected, at least one receive beam adjacent to the pair and at least one path delay in the maximum path detection range are used to define the vicinity.

27. The multibeam reception method according to claim 21, wherein, in the path detection range setting step, the path detection range is set so that the path detection range is confined only to the vicinity of respective

pairs of receive beam numbers and path delays calculated from the pairs of the receive beam numbers and the path delays previously detected and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays.

28. The multibeam reception method according to claim 27, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays calculated from the pairs of the receive beam numbers and the path delays previously detected and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, a combination of the receive beam number and the path delay is used as a condition to define the vicinity.

29. The multibeam reception method according to claim 27, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays calculated from the pairs of the receive beam numbers and the path delays previously detected and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, at least one receive beam adjacent to the pair is used to define the vicinity.

30. The multibeam reception method according to claim 27, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays calculated from the pairs of the receive beam numbers and the path delays previously detected and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, at least one path delay in the maximum path

detection range is used to define the vicinity.

31. The multibeam reception method according to claim 27, wherein, in the path detection range setting step, when the path detection range is confined only to the vicinity of the respective pairs of the receive beam numbers and the path delays calculated from the pairs of the receive beam numbers and the path delays previously detected and the information on the user signal reception quality in the respective pairs of the receive beam numbers and the path delays, at least one receive beam adjacent to the pair and at least one path delay in the maximum path detection range are used to define the vicinity.

32. The multibeam reception method according to claim 21, wherein, in the path detection range setting step, the path detection range is confined based on one or more pairs of receive beam numbers and path delays previously detected, which are selected according to a certain standard, and information on user signal reception quality in the pairs of the receive beam numbers and the path delays.

33. The multibeam reception method according to claim 32, wherein, as the pair of the receive beam number and the path delay previously detected which is selected according to a certain standard, at least one pair of a receive beam number and a path delay excellent in user signal reception quality is selected.

34. The multibeam reception method according to claim 32, wherein, as the pair of the receive beam number and the path delay previously detected which is selected according to a certain standard, at least one pair of a receive beam number and a path delay in which the user signal reception quality meets a certain standard of reception quality is selected.

35. The multibeam reception method according to claim 21, wherein, in the case where no pair of a receive beam number and a path delay suitable for use in demodulation has been detected in the path selecting step, the path detection range is set to cover all path delays and all receive beams.

36. The multibeam reception method according to claim 21, wherein, in the path selecting step, immediately after the initiation of reception, the path detection range is set to cover all path delays and all receive beams.

37. The multibeam reception method according to claim 21, wherein, in the path selecting step, the path detection range is set to cover all path delays and all receive beams periodically at intervals longer than the path detection interval.

38. The multibeam reception method according to one of claims 35 to 37, wherein, when the path detection range is set to cover all path delays and all receive beams, the resolution of the detection is reduced.